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EXAMINER	
WONG, EDNA	
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1753	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/761,542	HUNT, JEFFREY H.	
	Examiner	Art Unit	
	Edna Wong	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 July 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-38* is/are pending in the application.

4a) Of the above claim(s) *13-26* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12 and 27-38* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Election/Restrictions

Applicant's election without traverse of Group I, claims **1-12 and 27-38**, in the reply filed on July 30, 2007 is acknowledged.

The requirement is still deemed proper and is therefore made FINAL.

Accordingly, claims **13-26** are withdrawn from consideration as being directed to a non-elected invention.

Claim Rejections - 35 USC § 112

Claims **4, 7-12 and 27-38** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 4

lines 2-3, "the multiple ignition points" lack antecedent basis.

Claim 7

line 4, it appears that "a solid fuel" is the same as the solid fuel recited in claim 1, line 5. However, it is unclear if it is. If it is not, then what is the difference between the solid fuels.

Claim 9

line 4, it appears that "a solid fuel" is the same as the solid fuel recited in claim 1,

line 5. However, it is unclear if it is. If it is not, then what is the difference between the solid fuels.

Claim 12

line 3, "$+(\omega\tau)^2]$" is missing a beginning parenthesis.

line 4-5, "the laser pulse width" lacks antecedent basis. There is no laser claimed.

Claim 27

line 11, it is unclear what is meant by the words "by the to make".

Claim 30

lines 2-3, "the multiple ignition points" lack antecedent basis.

Claim 33

line 3, it appears that "a solid fuel" is the same as the solid fuel recited in claim 27, line 8. However, it is unclear if it is. If it is not, then what is the difference between the solid fuels.

Claim 35

lines 3-4, it appears that "a solid fuel" is the same as the solid fuel recited in claim 27, line 8. However, it is unclear if it is. If it is not, then what is the difference between the solid fuels.

Claim 38

line 4, "$+(\omega\tau)^2]$" is missing a beginning parenthesis.

lines 5-6, "the laser pulse width" lacks antecedent basis. There is no laser claimed.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

I. Claims **1 and 3-12** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Early** (US Patent No. 5,756,924) in combination with **Vorob'ev et al.** ("Laser Pulse Combustion of Solid Fuel", *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (1990), Vol. 16, No. 19, pp. 79-83).

Early teaches a method for initiating and sustaining a combustive reaction in a

fuel, said method comprising:

(a) generating at least one pulsed optical signal (= a short duration laser pulse and a long duration laser pulse) [col. 2, line 66 to col. 3, line 3];

(b) directing the pulsed optical signal to a plurality of ignition points (= the focal volume of the laser light within the fuel medium) [col. 7, lines 46-48; col. 7, lines 66-67; and Fig. 3] within at least one combustion chamber containing a fuel **28** (Fig. 3);

(c) modulating (= Q-switch modulation) [col. 7, lines 25-33] the pulsed optical signal to initially have a first peak power **1** (= an initial short duration high peak power pulse) [col. 5, lines 50-54; and Fig. 2] sufficient to initiate a combustive reaction in a solid fuel (= contacting a fuel with a short duration laser pulse to form a plasma and to initiate fuel combustion) [col. 2, line 66 to col. 3, line 3]; and

(d) modulating (= Q-switch modulation) [col. 7, lines 25-33] the pulsed optical signal to subsequently have a second peak power **2** (= a subsequent laser pulse of longer duration having significantly lower peak power) [col. 5, lines 50-54; and Fig. 2] sufficient to sustain the combustive reaction once the combustive reaction is initiated (= contacting said plasma with a long duration laser pulse, thereby stabilizing and sustaining said fuel combustion) [col. 3, lines 1-3].

Generating at least one pulsed optical signal comprises generating a plurality of pulsed optical signals (= a short duration laser pulse and a long duration laser pulse) [col. 2, line 66 to col. 3, line 3].

Directing the pulsed optical signal comprises directing each of the pulsed optical

signals to at least one of the multiple ignition points (= the focusing lens **26** is used to appropriately adjust the power density and *focal volume* of the laser light within the fuel medium) [col. 7, lines 46-48].

Generating at least one pulsed optical signal comprises generating the pulsed optical signal to have a wavelength sufficiently short (= an initial short duration high peak power pulse) [col. 5, lines 50-54; and Fig. 2] so that absorption of the pulsed optical signal by the solid fuel *leads to* molecular disassociation of the solid fuel (= contacting a fuel with a short duration laser pulse to form a plasma and *to initiate* fuel combustion) [col. 2, line 66 to col. 3, line 3].

Generating at least one pulsed optical signal comprises generating the pulsed optical signal to have a duration sufficiently short (= a subsequent laser pulse of longer duration having significantly lower peak power) [col. 5, lines 50-54; and Fig. 2] so that the signal will have sufficient energy *to generate the combustive reaction* of the solid fuel (= contacting said plasma with a long duration laser pulse, thereby stabilizing and sustaining *said fuel combustion*) [col. 3, lines 1-3].

Modulating the pulsed optical signal to initially have a first peak power comprises modulating the pulsed optical signal to have a first portion having a peak power (= an initial short duration high peak power pulse) [col. 5, lines 50-54; and Fig. 2] sufficient *to initiate* a combustive reaction in a solid fuel (= contacting a fuel with a short duration laser pulse to form a plasma and *to initiate* fuel combustion) [col. 2, line 66 to col. 3, line 3].

Modulating the pulsed optical signal to have a second peak power comprises modulating the pulsed optical signal to have a second portion having a peak power (= a subsequent laser pulse of longer duration having significantly lower peak power) [col. 5, lines 50-54; and Fig. 2] sufficient to *sustain the combustive reaction* until sufficient exothermic energy is released by the combustive reaction to make the reaction self-sustaining (= contacting said plasma with a long duration laser pulse, thereby stabilizing and *sustaining said fuel combustion*) [col. 3, lines 1-3].

Modulating the pulsed optical signal to initially have a first peak power comprises modulating *a plurality* of pulsed optical signals (= continuous or quasi-continuous alternating sequences of short duration high peak power and longer duration low peak power laser pulses can also be employed in practice) [col. 6, lines 4-35; and Fig. 2] wherein a first pulsed optical signal has a peak power (= an initial short duration high peak power pulse) [col. 5, lines 50-54; and Fig. 2] sufficient to *initiate* a combustive reaction in a solid fuel (= contacting a fuel with a short duration laser pulse to form a plasma and *to initiate* fuel combustion) [col. 2, line 66 to col. 3, line 3].

Modulating the pulsed optical signal to have a second peak power comprises modulating *at least one* second pulsed optical signal generated subsequent to the first pulsed optical signal (= continuous or quasi-continuous alternating sequences of short duration high peak power and longer duration low peak power laser pulses can also be employed in practice) [col. 6, lines 4-35; and Fig. 2] to have a peak power (= a subsequent laser pulse of longer duration having significantly lower peak power) [col. 5,

lines 50-54; and Fig. 2] sufficient to sustain the combustive reaction until sufficient exothermic energy is released by the combustive reaction to make the reaction self-sustaining (= contacting said plasma with a long duration laser pulse, thereby stabilizing and *sustaining said fuel combustion*) [col. 3, lines 1-3].

Generating at least one pulsed optical signal comprises generating the first pulsed optical signal a predetermined time prior to generating the second pulsed optical signal (= an initial short duration high peak power pulse **1** is followed by a subsequent laser pulse **2** of longer duration having significantly lower peak power) [col. 5, lines 50-54] so that all the energy of the second pulsed optical signal will be uniformly absorbed by the solid fuel without causing undesirable optical processes to interfere with the initiation of the combustive reaction (*inherent*).

The method of Early differs from the instant invention because Early does not disclose the following:

a. Wherein the fuel is a solid fuel, as recited in claim 1.

Early teaches that fuels which can be ignited using the method and apparatus of his invention include, but are not limited to, *hydrocarbon fuels* such as gaseous fuels or fuels which can be vaporized such as heating oil, kerosene, diesel, or jet fuels (col. 6, lines 44-48). In addition to *the laser induced ignition* of gaseous and aerosol fuels, this invention can be used for the precise excitation and detonation of *explosive or energetic materials* (col. 14, lines 49-52).

Like Early, Vorob'ev teaches the *laser pulse* combustion of fuel. The fuel is a solid fuel (abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the fuel described by Early with wherein the fuel is a solid fuel because a solid fuel, such as coal, would have been a suitable explosive or energetic material for laser pulse induced ignition or combustion as taught by Vorob'ev (abstract).

Furthermore, Early teaches that the laser light peak power energy requirements for ignition would have been reduced by his invention, resulting in energy efficiency and reduction in the size of lasers needed (col. 14, lines 9-11). Thus, using the ignition method disclosed by Early (col. 2, line 66 to col. 3, line 3) on a solid fuel would have reduced the laser light peak power energy requirements for ignition, resulting in energy efficiency and reduction in the size of lasers needed.

b. Wherein modulating the pulsed optical signal comprises modulating the pulsed optical signal in accordance with the equation:

$$I_{cr}=\{mcE_I(1+(\omega\tau)^2]/[2\pi e^2\tau]\}[g+1/\tau_p \log_e(\rho_{cr}/\rho_0)]$$

where ρ_{cr} is the critical electron number for breakdown, τ_p is the laser pulse width; m, e, c are the electron constants; ϖ is the optical field frequency; E_I is the ionization energy of the solid fuel or an oxidizer; τ is the momentum transfer collision time; g is the electron loss rate; and ρ_o is the initial electron density, as recited in claim

12.

Early teaches that a single laser source **20** which can alternately produce high peak power/short duration pulses and low peak power/longer duration pulses can be employed in the apparatus. Such a laser light source may produce both short duration and long duration laser pulses by use of sequential fast and slow Q-switch modulation or by a combination of Q-switching, mode-locking, cavity dumping and free lasing modes of operation (col. 7, lines 25-33).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modulating the pulsed optical signal described by Early with wherein modulating the pulsed optical signal comprises modulating the pulsed optical signal in accordance with the equation:

$$I_{cr}=\{mcE_I(1+(\omega\tau)^2]/[2\pi e^2\tau]\}[g+1/\tau_\rho \log_e(\rho_{cr}/\rho_0)]$$

where ρ_{cr} is the critical electron number for breakdown, τ_p is the laser pulse width; m, e, c are the electron constants; ϖ is the optical field frequency; E_I is the ionization energy of the solid fuel or an oxidizer; τ is the momentum transfer collision time; g is the electron loss rate; and ρ_o is the initial electron density because the derivation of the modulation may not impart patentability to a process if the claimed limitation does not produce new and unexpected results which are different in kind and not merely in degree from results of the prior art, such method limitations are termed "critical" and Applicant has the burden of proving such criticality; even though Applicant's modification results in great improvement and utility over the prior art, it may

still not be patentable if the modification was within capabilities of one skilled in the art; more particularly, where general conditions of the claim are disclosed in the prior art, it is not inventive to discover optimum or workable ranges by routine experimentation.

II. Claim **2** is rejected under 35 U.S.C. 103(a) as being unpatentable over **Early** (US Patent No. 5,756,924) in combination with **Vorob'ev et al.** ("Laser Pulse Combustion of Solid Fuel", *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (1990), Vol. 16, No. 19, pp. 79-83) as applied to claims 1 and 3-12 above, and further in view of **Zhang** ("Laser-Induced Ignition of Pulverized Fuel Particles", *Combustion and Flame* (1992), Vol. 90, pp. 134-142).

Early and Vorob'ev are as applied above and incorporated herein.

The method of Early differs from the instant invention because Early does not disclose wherein directing the pulsed optical signal comprises utilizing an optical fiber coupler including a plurality of optical fibers to transmit the pulsed optical signal to the plurality of ignition points, as recited in claim 2.

Like Early, Zhang teaches the laser-induced ignition of fuel (page 134, abstract). Zhang teaches that the apparatus consisted of a laser, focusing optics and an optical fiber. A 100/140-μm multi-mode optical fiber delivered the light from the laser to the sample particles (page 135, "Apparatus").

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the directing of the pulsed optical signal described

Early by utilizing an optical fiber coupler including a plurality of optical fibers to transmit the pulsed optical signal to the plurality of ignition points because an optical fiber would have delivered the light from the laser to the sample as taught Zhang (page 135, "Apparatus"; and Fig. 1).

The selection of old parts to operate in new environments in order to achieve the same results was held to have been obvious. *In re Ross* 105 USPQ 237. And the substitution of known equivalent structures was held to have been obvious. *In re Ruff* 118 USPQ 343 (CCPA 1958).

III. Claims **27 and 29-38** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Early** (US Patent No. 5,756,924) in combination with **Vorob'ev et al.** ("Laser Pulse Combustion of Solid Fuel", *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (1990), Vol. 16, No. 19, pp. 79-83).

Early and Vorob'ev are as applied for the reasons as discussed above and incorporated herein.

IV. Claim **28** is rejected under 35 U.S.C. 103(a) as being unpatentable over **Early** (US Patent No. 5,756,924) in combination with **Vorob'ev et al.** ("Laser Pulse Combustion of Solid Fuel", *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (1990), Vol. 16, No. 19, pp. 79-83) as applied to claims 27 and 29-38 above, and further in view of **Zhang** ("Laser-Induced Ignition of Pulverized Fuel Particles", *Combustion and Flame* (1992),

Vol. 90, pp. 134-142).

Early, Vorob'ev and Zhang are as applied for the reasons as discussed above and incorporated herein.

Citations

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Kime (US Patent No. 4,276,463) is cited to teach the laser disintegration of solid fuel particles by laser beams in an environment consisting of a gaseous substance with insufficient oxygen to support combustion.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Edna Wong
Primary Examiner
Art Unit 1753

EW
August 9, 2007